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OPTIONS AND OPPORTUNITIES FOR POLICYMAKERS

ADELE C. MORRIS
The Brookings Institution

YORAM BAUMAN
Carbon Washington

DAVID BOOKBINDER
Niskanen Center

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YORAM BAUMAN
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EXECUTIVE SUMMARY

Pricing carbon dioxide and other greenhouse gases (GHGs) would address the market failure inherent in an economy that doesn't price damaging emissions. Much has been written about the design of a federal-level carbon tax. This paper adapts these findings to the state level, motivated by pending federal regulations (which place implementation obligations on states), policy discussions in states with commitments to ambitious long-term emissions targets, and state budget shortfalls that could necessitate new revenue. Notwithstanding the myriad political impediments to a carbon tax, this paper explains how state policymakers can design one to fit their fiscal, economic, distributional, and environmental goals.

A state-level carbon tax, particularly if set above prevailing emissions allowance prices in state cap-and-trade programs and applied economy-wide, could raise enough revenue in many states to play a substantial fiscal role; a $20 per ton tax on energy-related CO_2 emissions could raise up to two or three percent of state GDP in the most emissions-intensive states. That is significant for a state tax; nationally, on average states collect only about five percent of GDP total from their own revenue instruments, including sales, property, income, and business taxes. A tax that rises at an annual rate above inflation should produce a reliable revenue source for decades even while it reduces emissions.

States face many choices, including the sectors and sources of GHGs to cover, the point in the supply chain of fossil fuels at which to impose the tax, and other policy design elements. Importantly, the point of taxation is largely independent of who actually bears the economic burden of the tax because upstream producers or distributors will pass their costs along to those who buy their products. Thus states can choose a point of taxation that maximizes coverage, minimizes the number of taxpayers, and/or or coincides with existing state or federal tax or GHG reporting obligations.

This paper reviews those and a host of other options regarding:

- the tax treatment of carbon embodied in fuels, electricity, and goods that are imported or exported from the state;
- tradeoffs arising across addressing the disproportionate burdens on low-income households and using the revenue in ways that promote economic growth;
- how states can harmonize policies to avoid distortions in investment and trade; and
- how a carbon tax can feature in state implementation plans for the Clean Power Plan and EPA rules under the Clean Air Act.

1. INTRODUCTION

Greenhouse gas emissions (GHGs) contribute to the risk of climatic disruption. The largest component of GHG emissions, carbon dioxide (CO_2), also contributes to ocean acidification. Pricing carbon dioxide and other greenhouse gases, either through a tax or a cap-and-trade system, would address the market failure inherent in an economy that doesn't price damaging emissions. Much has been written on the advantages and disadvantages of a tax approach relative to other climate policies, and a number of studies have surveyed the design issues of a U.S. carbon or GHG tax at the federal level.[1] This paper extends the literature to examine the design issues for such a tax at the *state* level, some of which are analogous to issues at the state level, and some of which are unique to states.

Some of the issues that arise for states include: which entities, sources, and sectors that states can feasibly tax; the role of existing state policies; the treatment of traded fuels, electricity, and goods; and the potential uses of the revenue, including the set of state revenue instruments that can be involved in a tax swap. For example, this paper describes the challenges of identifying the tax base for transportation fuels in a way that thwarts avoidance of the tax via filling tanks in other jurisdictions. Also, we describe how states may have existing excise fuel taxes they can use as bases for a carbon tax, thereby adding little additional administrative burden. At the same time, however, states may have constitutional provisions that dictate the disposition of fuel tax revenues, for example targeting it exclusively to state highway trust funds. Finally, states are facing federal regulations on power plant carbon emissions. This creates an action-forcing event that may raise the appeal of a policy option that not only produces environmental benefits but can also address other pressing fiscal needs.

Here we'll use the term "carbon tax" for short, but the tax might actually apply to either the carbon content of fossil fuels before combustion or the CO_2 in combustion gases. The tax might also apply to other GHGs, such as methane from landfills and coal beds, provided the emissions can be measured and attributed to responsible parties.

Several factors are converging to motivate work on the design of state-level carbon taxes. First, a carbon tax is one way states can comply with regulations the U.S. Environmental Protection Agency (EPA) has begun promulgating under Section 111(d) of the Clean Air Act. In the Clean Power Plan (CPP) rule, EPA imposed state-specific targets for CO_2 emissions from electric

[1] Mathur and Morris (2014) http://www.brookings.edu/~/media/research/files/papers/2014/05/22-carbon-tax-broader-us-fiscal-regulation-morris/05222014_carbon_tax_broader_us_fiscal_reform_morrisa_mathura.pdf; Parry et al (2015) https://www.amazon.com/Implementing-Carbon-Tax-Explorations-Environmental/dp/1138825360?ie=UTF8&*Version*=1&*entries*=0; Marron and Morris (2016) http://www.brookings.edu/~/media/research/files/papers/2016/02/23-carbon-tax-revenue/howtousecarbontaxrevenuemarronmorris.pdf. This paper draws from these works in areas in which federal and state carbon tax design principles are similar.

power plants. The rule allows states to include carbon fees in their State Implementation Plans (SIPs) to achieve their targets.[2] Although the U.S. Supreme Court has stayed the implementation of the rule until further proceedings, some states are continuing their consideration of their options for implementing the rule. We return to this in Section 5 below.

Second, a number of states have committed (either in law or in aspiration) to deep, long-term emissions reduction targets that will require significant abatement outside the electricity sector. For example, Massachusetts, New York, and Rhode Island all have targets to reduce their GHG emissions by 80 percent of 1990 levels by 2050, and Oregon and Vermont have goals of 75 percent reductions of 1990 levels by 2050.[3] Some advocates in these states are pushing the idea of a carbon tax or fee (we'll use both terms here) as a keystone policy to attain those goals.[4] A wide variety of approaches to the design of a state carbon fee are under discussion. Some advocates are taking inspiration from the economy-wide revenue-neutral carbon tax approach adopted by British Columbia. For example, Initiative 732[5] heading to the November 2016 ballot in Washington State would institute a gradually rising carbon tax starting at $15 per metric ton of CO_2 on fossil fuels sold or consumed in the state.[6] The measure would use the revenue to reduce the state sales tax by one percentage point, fund a tax rebate for low-income working households, and effectively eliminate a tax on manufacturers.

California is facing unique challenges that may motivate consideration of a carbon tax there. The state's Assembly Bill 32, the Global Warming Solutions Act of 2006, established a statewide target of returning greenhouse gas emissions to their 1990 levels by 2020. Although AB 32 includes the use of a cap-and-trade system that now covers approximately 85 percent of state emissions, the state also controls those emissions with numerous regulatory policies. Among the tradable allowance program's problems is a pending legal challenge by business groups to its constitutionality under the logic that it has tax-like qualities but was not passed with the requisite two-thirds majority of the legislature. A second uncertainty surrounds the legality of tightening the targets in the allowance market past 2020 without legislative reauthorization.[7] Also, owing to both the regulatory measures and the legal uncertainties, the allowance price has remained below expectations, with auctions clearing consistently at the floor price and secondary market prices dipping below that. One might argue that if the extension of the cap-

[2] https://www.epa.gov/cleanpowerplan/clean-power-plan-existing-power-plants
[3] http://www.rff.org/blog/2016/look-six-state-proposals-tax-carbon
[4] A compendium of state carbon price campaigns appears here: http://www.usclimateplan.org/#!scpn-states-at-a-glance/wb2wj. A review of carbon pricing legislative proposals in Massachusetts is available here: http://climate-xchange.org/resources/.
[5] Yoram Bauman, a co-author of this paper, is the founder of Carbon Washington and co-chair of the campaign for this initiative.
[6] http://yeson732.org/plain-language/
[7] Cullenward, Danny and Andy Coghlan, "Structural oversupply and credibility in California's carbon market," *The Electricity Journal*, Volume 29, Issue 5, June 2016, Pages 7–14. http://www.sciencedirect.com/science/article/pii/S1040619016300707

and-trade program has to be reauthorized with a supermajority and the auction is consistently clearing at the floor price, California leaders may as well consider converting the policy into a tax. This would also provide a valuable example for how a federal program might work.

Some states, much like the federal government, face serious long-term fiscal challenges and may need to raise revenue. Some may find a revenue source that can cost-effectively replace more costly subsidies and mandates, as well as achieve compliance with new EPA regulations, to be particularly attractive. Thirty-nine states require the budgets their legislatures pass to be balanced, and they now face looming unfunded pension liabilities, depleted rainy day funds, falling revenue from extractive industries, growing health care and education costs, infrastructure in disrepair, and the accumulated burden of unsustainable budget tactics.[8] Other states without compelling budget pressures may consider a pro-growth tax reform that swaps a carbon tax for revenue sources that more negatively impact economic growth, such as taxes on business activity.

Despite all of these potential drivers, and as sensible as most economists believe a carbon fee is, the political headwinds to carbon pricing are undeniable. Some stakeholders are concerned about climate policy of any kind, and others are more worried about the effects of a carbon price per se. Significant debate surrounds the competitiveness effects of unilateral state action, even while others argue that states must lead in the absence of more comprehensive federal policy. The goal of this paper is less to describe how these myriad political impediments can be overcome—that will vary greatly by state—than to assure policymakers in all states that they can design a carbon tax to fit their fiscal, economic, distributional, and environmental goals. With appropriate consideration of the issues discussed in this paper, a carbon fee offers state leaders a responsible way to achieve both fiscal and environmental objectives, whether the underlying motivation derives from a concern about the global climate, budget needs, federal regulatory requirements, or a combination thereof.

Outline of this paper

No particular common approach has emerged across states that are considering a carbon tax, so one of our goals here is to elucidate the advantages and disadvantages of different options, recognizing one person's pro might be another's con. Many options for key policy design elements arise, such as whether the tax would supplement or displace existing state policies, the emissions sources and sectors to cover, the carbon price trajectory, and what to do with the revenue.[9] We consider each of these issues in this paper with an eye to informing the

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[8] http://www.ncsl.org/research/fiscal-policy/state-balanced-budget-requirements.aspx; http://media.navigatored.com/documents/StateofStatePensionsReport.pdf; http://www.statebudgetsolutions.org/publications/detail/state-budget-gimmicks-of-2015

[9] http://www.rff.org/blog/2016/putting-carbon-tax-revenues-work-efficiency-and-distributional-issues

options for state policymakers and stakeholders.[10] We also explain how states could use a tax approach to achieve compliance with GHG emissions standards imposed by EPA.

The paper proceeds as follows: Section 2 describes how much revenue states might expect to raise with a fee on carbon and illustrates how in some states it could play an important fiscal, as well as environmental, role. In Section 3, we explore the challenge of setting a tax base, i.e. the fossil fuels and/or GHG emissions sources that would be subject to the tax. It also describes how states may set its initial rate and a course for the tax to change over time. Section 4 reviews the potential distributional outcomes of the tax and ways to use the revenue at the state level, with particular attention to approaches that can attract investment and boost economic growth, offsetting the burden of the carbon tax. Section 5 describes how states can incorporate a carbon tax into their compliance plans for EPA regulations under Section 111 of the Clean Air Act. Section 6 concludes by comparing a carbon tax with other potential state-level climate and energy policies, both for regulatory compliance and for economy-wide emissions reductions.

2. REVENUE

The states that have begun pricing carbon through cap-and-trade programs have so far used allowance auction revenue primarily for environmental goals. For example, California's aforementioned AB 32 and the Regional Greenhouse Gas Initiative (RGGI) for power sector emissions in nine northeastern states both earmark allowance auction revenue for environment-related purposes.[11] A study of the cumulative $1.4 billion in RGGI auction proceeds from 2008 to 2013 reports that the large majority of the revenue went to energy efficiency programs, energy bill assistance, and other GHG abatement activities.[12] However, some RGGI states have shown interest in using the revenue for non-environmental purposes. For example, in 2010, New York used half of its revenue and New Jersey used all of its RGGI funds (prior to departing from the program the following year) to balance their budgets.

A state-level carbon tax, particularly if set above the price signals operating in existing cap-and-trade programs and applied economy-wide, could raise enough revenue in many states to play a substantial fiscal role.[13] How much revenue? Table 1 below shows the 2013 energy-related CO_2 emissions by state in tons as reported by the U.S. Department of Energy's Energy Information

[10] A review of these policy design issues for a federal carbon price policy appears here: http://www.brookings.edu/research/papers/2016/07/08-eleven-questions-designing-price-on-carbon-morris

[11] http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/auctionproceeds.htm; https://www.rggi.org/rggi_benefits

[12] http://rggi.org/docs/ProceedsReport/Investment-RGGI-Proceeds-Through-2013.pdf

[13] According to the RGGI website, the clearing price for allowances at the March 2016 RGGI auction was $5.25 per ton of CO_2, raising a total of $77.9 million. http://www.rggi.org/docs/Auctions/31/PR031116_Auction31.pdf

Administration (EIA).[14] The table provides an illustrative estimate of the potential revenue in each state, both in millions of dollars and as a share of state GDP in 2013, by multiplying each state's fossil fuel CO_2 emissions inventory by a hypothetical tax of $20 per ton of CO_2.[15] Of course, the actual revenue in any state would depend on details of the tax base, the tax rate, how emissions respond to the price signal, and the policy and macroeconomic shifts that could lower revenues from other tax instruments. But this estimate at least indicates the order of magnitude of revenues available should policymakers wish to consider a carbon tax option.

Table 1. Energy-related CO_2 emissions and potential carbon tax revenue by state

	Per capita energy-related carbon dioxide emissions by state in 2013	**2013 Electric Power Fossil Fuel Combustion CO_2**	**2013 Industrial Fossil Fuel Combustion**	**Total including transport**	**Total potential revenue, assuming 2013 emissions and tax rate of $20/ton CO_2**	**Total carbon tax potential revenue as a share of state GDP in 2013**
	metric tons CO_2 per person[16]	**$MMTCO_2$**	**$MMTCO_2$**	**$MMTCO_2$**	**million$**	
Alabama	24.8	64.20	21.30	119.8	2,396	1.24%
Alaska	49.0	2.60	17.50	36.1	722	1.26%
Arizona	14.1	54.70	4.50	93.8	1,875	0.68%
Arkansas	22.9	35.50	9.20	67.8	1,356	1.17%
California	9.2	45.70	72.90	353.1	7,062	0.32%
Colorado	17.2	38.50	13.80	90.5	1,810	0.63%
Connecticut	9.5	6.80	2.30	34.3	686	0.28%
Delaware	14.5	4.10	3.70	13.4	268	0.44%
District of Columbia	4.3	0.00	0.00	2.8	56	0.05%
Florida	11.1	104.60	11.00	217.6	4,353	0.54%
Georgia	13.3	53.60	14.40	132.5	2,650	0.59%
Hawaii	12.9	6.80	1.50	18.3	365	0.49%
Idaho	10.4	1.30	3.50	16.7	335	0.55%
Illinois	17.9	89.00	40.30	230.2	4,604	0.64%

[14] http://www.eia.gov/environment/emissions/state/analysis/
[15] GDP data from the U.S. Bureau of Economic Analysis: http://www.bea.gov/regional/downloadzip.cfm
[16] Population data from U.S. Census Bureau: http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml

Indiana	30.4	98.40	46.40	199.8	3,995	1.30%
Iowa	25.8	32.10	18.90	79.9	1,599	0.97%
Kansas	25.1	32.00	15.80	72.8	1,455	1.04%
Kentucky	31.1	86.10	16.20	137.0	2,741	1.51%
Louisiana	42.0	40.80	105.40	194.5	3,890	1.59%
Maine	12.2	1.40	2.40	16.2	324	0.61%
Maryland	9.7	17.40	2.60	57.9	1,157	0.34%
Massachusetts	9.7	12.60	3.80	65.3	1,306	0.30%
Michigan	16.2	62.10	20.50	160.2	3,204	0.74%
Minnesota	16.3	25.70	18.30	88.6	1,773	0.58%
Mississippi	20.1	21.60	11.30	60.2	1,203	1.17%
Missouri	21.7	75.80	9.10	131.3	2,626	0.96%
Montana	31.3	16.40	4.60	31.7	635	1.49%
Nebraska	28.4	26.00	9.30	53.0	1,061	0.99%
Nevada	12.8	15.40	2.40	35.8	716	0.56%
New Hampshire	10.5	3.30	0.80	14.0	27	0.41%
New Jersey	11.8	14.40	9.70	105.1	2,103	0.39%
New Mexico	25.8	28.20	8.40	53.9	1,077	1.21%
New York	8.1	30.00	9.50	160.3	3,206	0.24%
North Carolina	12.4	55.50	10.70	122.4	2,448	0.53%
North Dakota	78.2	28.70	16.10	56.6	1,132	2.18%
Ohio	19.8	101.50	38.30	228.7	4,574	0.82%
Oklahoma	26.8	44.20	22.20	103.1	2,062	1.17%
Oregon	9.8	9.00	4.70	38.4	768	0.38%
Pennsylvania	19.1	105.90	49.60	243.9	4,878	0.77%
Rhode Island	9.5	2.60	0.60	10.0	200	0.38%
South Carolina	14.5	28.20	7.90	69.2	1,383	0.76%
South Dakota	17.9	3.10	3.90	15.2	303	0.68%
Tennessee	14.9	33.60	16.50	96.7	1,934	0.67%
Texas	24.2	226.20	189.10	641.0	12,820	0.82%
Utah	22.9	34.90	8.30	66.4	1,328	0.99%
Vermont	8.9	0.00	0.40	5.6	112	0.39%

Virginia	12.5	30.90	12.90	103.0	2,060	0.46%
Washington	10.5	11.70	12.60	73.1	1,463	0.36%
West Virginia	50.3	68.70	10.40	93.3	1,865	2.66%
Wisconsin	17.3	43.30	14.00	99.5	1,990	0.71%
Wyoming	117.3	46.20	12.60	68.4	1,368	3.29%
TOTAL	16.7	2,021.30	962.10	5,278.64	105,573	0.64%

Table 1 shows that some jurisdictions, such as the District of Columbia and Vermont, would raise relatively little revenue from a carbon tax. That is generally because they either have no power plants within their borders or because they already have low-carbon electricity sectors, for example by relying mainly on hydropower. Other states, such as Wyoming and West Virginia, could raise over two percent of their state GDP from a $20 per ton tax on fossil energy-related CO_2 emissions.[17] Two percent of GDP is significant for a state tax; nationally, on average states collect only about five percent of GDP from their own revenue instruments, including sales, property, income, and business taxes (not counting transfers from the federal government).[18]

Forecasting revenue from the carbon fee involves multiplying the scheduled tax rates by a forecast of emissions subject to the tax. Revenues will depend on fluctuating demand for fossil energy, for example owing to weather and economic conditions, along with the responsiveness of fossil energy demand to the carbon price. These factors will vary significantly by state, depending on the existing energy mix, emissions patterns, and economic activity.

Despite the uncertainties in forecasting carbon tax revenues, states may find that carbon fees are less volatile than other state revenue sources.[19] For example, one major challenge that California faces is the pro-cyclical nature of its revenue stream; revenues fall just as economic activity falls and demands on social safety net programs rise. A recent study concluded that there are several factors behind California's relatively high degree of revenue volatility, notably "the extraordinary boom and bust in stock market-related revenues from stock options and capital gains."[20] Replacing or supplementing volatile sources of revenue (such as taxes on capital gains and corporate income) with a carbon tax would help stabilize state finances and avoid a

[17] Data do not include emissions from uncombusted fuels exported from the state.
[18] http://www.taxpolicycenter.org/briefing-book/what-are-sources-revenue-state-governments; http://www.urban.org/sites/default/files/alfresco/publication-pdfs/2000376-Long-Term-Trends-in-State-Finances.pdf
[19] A recent study by Pew Charitable Trusts documents the increasing volatility of state revenues. http://www.pewtrusts.org/en/research-and-analysis/reports/2015/03/managing-volatile-tax-collections-in-state-revenue-forecasts
[20] http://www.lao.ca.gov/2005/rev_vol/rev_volatility_012005.htm

boom-and-bust cycle of funding for programs like schools and social welfare programs. We return to the issue of revenue use in Section 4 below.

The revenues from a carbon tax are subject to a (desirable) erosion of the tax base, particularly over the long run as capital in long-lived power plants and other industrial facilities turns over. States with relatively high coal use in their electricity sectors are likely to experience more emissions abatement than states in which relatively more emissions reductions need to come from transportation. If states adopt tax rates that rise in real terms, the rising rate can more than counteract the decline in the tax base. In that case, it could take decades before states need worry about declining carbon tax revenues.

3. THE TAX BASE, RATE, AND TRAJECTORY

The most economically efficient GHG tax would fall broadly across all emissions of GHGs to the extent that authorities can feasibly attribute the emissions to a particular entity. This would equalize the incentives to abate all covered emissions at an incremental cost equal to the tax rate. However, a number of important decisions arise for states in deciding how broadly and ambitiously they wish to price GHGs, which entities in the supply chain of fossil energy to tax, and how tax rates should change over time.

Considerations regarding the point of taxation

The point of taxation refers to which entities would be required to monitor and report emissions and make payments.[21] For example, a state could impose the tax liability on fuel producers, distributors, or the facilities and consumers that combust them. Importantly, the point of taxation is largely independent of who actually bears the economic burden of the tax because upstream producers or distributors will pass their costs along to those who buy their products.[22] That means that states can opt to impose the tax in a way that minimizes administrative costs and/or maximizes coverage.

If policymakers were taxing carbon at the federal level, the most efficient point of taxation would likely be at the choke point in the fossil energy distribution system, making for fewer taxpayers and greater coverage of emissions. In that context, the point of taxation for coal could coincide with the point of first sale at which the federal government already imposes a coal excise tax.[23] For natural gas and oil, a reasonable approach would be to impose the tax at processors and refineries. A federal tax would also apply to imported fuels at the border.

[21] CBO (Ramseur et al) 2012: http://www.c2es.org/docUploads/R42731.pdf
[22] One exception could be certain regulated electricity markets in which price signals may be transmitted with significant lags.
[23] https://www.irs.gov/pub/irs-mssp/coal.pdf

At the state level, however, the easiest point of taxation is probably further downstream in the supply chain of fuels. For example, it may coincide with the point of existing EPA data collection for stationary sources and existing state fuel excise taxes for transportation fuels. Large industrial emitters, including power plants, refineries, and a wide range of industrial facilities must report their GHG emissions to EPA each year. EPA makes this data publicly available and any state can use this information to identify potential taxable emissions and estimate their potential revenues under different assumptions about which facilities would be subject to the tax. [24]

In addition, nearly all states already tax liquid transportation fuels; in July 2015, those taxes averaged 26.49 cents per gallon for gasoline and about 27.24 cents per gallon for diesel fuel (the federal taxes were 18.4 and 24.4 cents, respectively).[25] Some states also have taxes on natural gas, in some cases levied on distributors and in others levied on households. For example, Virginia imposes a tax on natural gas consumption.[26] A state carbon tax would apply similarly in that taxing authorities would calculate the per-unit tax for each fuel based on the carbon content of that fuel. For example, a carbon tax of $25 per ton of CO_2 would convert to about $1 per thousand cubic feet of natural gas.[27] It would add about 24 cents per gallon to the price of gasoline and about 28 cents per gallon to the price of diesel fuel.[28]

Sources covered

States must identify which sources and sectors will be subject to the tax. For example, for carbon in fossil fuels, this means choosing whether to tax carbon in fuels in electric power production (mainly coal and natural gas), transportation fuels (primarily petroleum products), fuels used in homes and commercial buildings for heating and cooling, and/or fuels used in industrial processes. Figure 1 below shows the energy-related emissions by state in 2013 in million metric tons of CO_2.[29] The chart shows CO_2 emissions directly related to fossil fuel combustion in each state. The biggest emitters tend to be large states with fossil-intensive industries and/or coal-intensive electricity sectors. States like California and Massachusetts that have relatively low emissions per person (see Table 1) tend to have relatively high shares of emissions from vehicle fuels.

[24] https://ghgdata.epa.gov/ghgp/main.do
[25] https://www.eia.gov/tools/faqs/faq.cfm?id=10&t=10
[26] http://law.lis.virginia.gov/vacode/title58.1/chapter29.1/section58.1-2904/
[27] http://www.rff.org/blog/2012/considering-carbon-tax-frequently-asked-questions#Q10
[28] Calculations based on EIA information available here: http://www.eia.gov/tools/faqs/faq.cfm?id=307&t=11.
[29] http://www.eia.gov/environment/emissions/state/analysis/

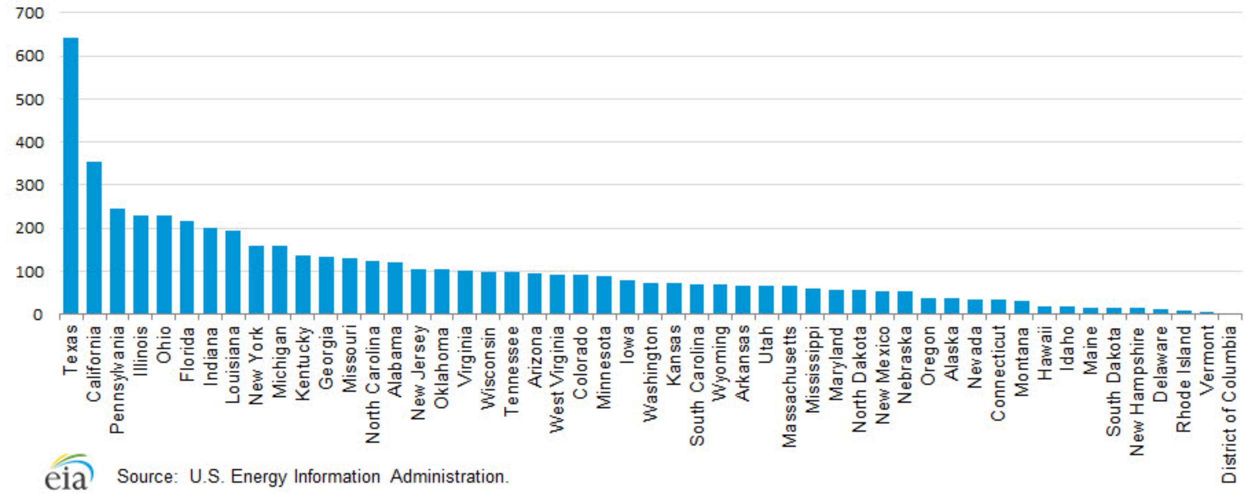

Figure 1. Energy-related emissions by state, 2013
million metric tons carbon dioxide

Non-fossil carbon, such CO_2 emitted in cement manufacturing, could also be subject to the fee. Other potentially taxable emissions include methane (CH_4) from landfills, coal mines, wells, pipelines, and processing facilities. Although these options could be politically infeasible, in principle states may even consider taxing methane associated with livestock production, carbon emitted from human activities in terrestrial ecosystems (such as tilling croplands and timber harvesting), and emissions of especially potent greenhouse gases used as refrigerants and in certain manufacturing processes.[30]

The "dormant" Commerce Clause of the U.S. Constitution prohibits states from taxing fuels that are simply passing through the state, but they may be able to apply the fee to fuels that are refined and then sold outside the state.[31] For example, it is clear that states cannot tax carbon in coal transiting the state by rail. However, a state may be able to tax carbon in crude oil that is produced and/or refined in the state, even if the refined products are shipped elsewhere.

The broader the scope of coverage, the greater the potential environmental benefits and revenue, but the more administratively complex and potentially politically fraught the program could be. Numerous decisions arise in establishing the tax base, and they may seem picayune, but they can have important implications for certain stakeholder groups and incentives for both abatement and investment in the state. We next review some of these specific administrative considerations for different sources and sectors; many states have will have particular considerations given their unique industrial bases.

Petroleum processes and products

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[30] A full inventory of U.S. GHG emissions appears here: http://www3.epa.gov/climatechange/ghgemissions/usinventoryreport.html.

[31] https://www.law.cornell.edu/wex/commerce_clause

Petroleum products involve both emissions "upstream" (such as fugitive methane from oil wells orCO_2 from wellhead flaring and refinery operations) and "downstream" (such as those from driving a car). Bulk storage terminals, a midway point between upstream and downstream operations, are the collection point for many federal and state fuel taxes and could offer a useful point of taxation for carbon in these fuels.[32] For example, for many states the easiest point of carbon taxation for motor vehicle fuels would coincide with their taxes on motor gasoline and diesel. Emissions from refinery operations and wellheads can be taxed based on reports to the EPA emissions database or similar reports.[33]

An important legal consideration for a carbon tax on vehicle fuels is that some state constitutions direct motor fuel tax revenue exclusively into a state highway or transit fund. See for example, the constitutions of California (Article XIX), Oregon (Article IX, Sec. 3a), or Washington (Article II, Sec. 40).[34] Whether these constitutional restrictions would apply to carbon tax revenues depends on the specific language and interpretation in each state, and the state's interpretation may be subject to litigation. One way around this could be to impose the carbon tax on crude oil rather than motor fuel, but many states don't refine their own liquid fuels; they would have to figure out how to tax carbon in imported refined products. Another option would be to allow carbon tax revenue from motor fuels to displace any general revenue that states were spending on highway infrastructure. For example, the Tax Foundation reports that state and local governments spend about twice as much on highway, road, and street expenses as they raise in vehicle-related tolls, fuel taxes, and license fees.[35] Thus, even if the carbon tax revenue does end up earmarked for a highway fund, it could free up revenue that could be used in other ways.

Two provisos apply to the general observation that it makes sense to apply carbon taxes on gasoline and diesel along with ordinary state fuel excise taxes. The first is that taxing carbon in diesel fuel used for trucking may best be done through the International Fuel Tax Agreement (IFTA).[36] The IFTA is an existing arrangement for dividing fuel taxes between the lower 48 states and Canadian provinces based on miles driven in the various jurisdictions; thus, using IFTA for carbon taxes could reduce concerns about interstate trucking competitiveness. Another consideration is that some diesel fuels (such as those used by non-highway farm equipment, construction equipment, and public school districts) are "dyed diesel" fuels that are

[32] https://www.fhwa.dot.gov/motorfuel/faqs.htm
[33] https://www.epa.gov/sites/production/files/2015-10/documents/subpart_w_2014_data_summary_10-05-2015_final.pdf
[34] http://www.leginfo.ca.gov/.const/.article_19; https://www.oregon.gov/ODOT/CS/FS/pages/article_ix.aspx; http://leg.wa.gov/LawsAndAgencyRules/pages/constitution.aspx
[35] http://taxfoundation.org/article/gasoline-taxes-and-user-fees-pay-only-half-state-local-road-spending
[36] http://www.truckpermits.net/trucking-permits/ifta-permits.html

not subject to many federal or state taxes. [37] States may or may not choose to impose a carbon tax on these dyed fuels, but the tax bill should make it clear either way.

Petroleum fuels are also used in planes and boats. There are several considerations in taxing the carbon in these fuels, some of which may also apply to railroad fuels. One is whether to discriminate across the uses of the fuel. For example, the carbon tax in British Columbia applies only to jet and boat fuel on trips that both originate and terminate inside BC. [38] Concerns about tankering (fueling up in other jurisdictions to avoid the tax) or economic competitiveness in the transport industries may have been behind these decisions, but it is also possible that they were driven by emissions accounting standards. According to standard GHG accounting methodologies developed by the Intergovernmental Panel on Climate Change, national emissions inventories do not include fuel used on international trips.[39] Another approach would be to account for half of the carbon emissions associated with trips to or from another jurisdiction. This logic explains why the designers of the I-732 carbon tax proposal in Washington State opted to tax fuels loaded onto planes or boats in Washington State, regardless of destination.

States may be able to disincentivize tankering by taxing carbon in fuel that is brought into the state in the fuel supply tank of a plane or boat, i.e., by not extending the exemption discussed above for vehicles to boats and planes. This would impose administrative costs, and states would have to decide whether it is worth the trouble. Taxing carbon in fuel tanks would probably be particularly feasible for arriving airplanes because airlines closely track fuel levels. However, airplanes have a more limited scope to avoid the tax than cargo ships because they can carry less fuel, and they incur a significant cost in carrying extra fuel.

A legal consideration also surrounds the disposition of revenue from a fee on the carbon in jet or boat fuel; it arose in the context of the I-732 campaign in Washington State. An airline there has argued that the state cannot tax carbon in jet fuel because 49 U.S.C. § 47133 earmarks aviation fuel taxes to airport-related spending; however, this law refers only to "local taxes" and so may not include state taxes.[40] On the other hand, another federal statute (49 U.S.C. § 47107(l)(1)) and a related federal regulation make federal Department of Transportation (DOT) grants contingent on how states (not just localities) use their aviation-fuel-related revenues.[41] In other words, states that do not apply aviation-fuel-related tax revenue towards airport-related expenditures may not be eligible for federal funding for DOT grants to airports. The significance of this, along with the possible relevance of other state-level statutes and

[37] http://www.dol.wa.gov/vehicleregistration/dyeddiesel.html
[38] California excludes jet fuel from its cap-and-trade program. See 17 CCR 95811.
[39] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_3_Ch3_Mobile_Combustion.pdf
[40] https://www.law.cornell.edu/uscode/text/49/47133
[41] https://www.law.cornell.edu/uscode/text/49/47107; https://www.gpo.gov/fdsys/pkg/FR-2014-11-07/pdf/2014-26408.pdf

potential international legal considerations, suggest that state policymakers give careful consideration of the tax treatment of these fuels.

Two other considerations arise in drafting state bills that would tax carbon in aircraft fuel. One is that laws and regulations often treat "jet fuel" and "airplane fuel" differently, so the terminology in the bill may matter to certain stakeholders. The former generally refers to the kerosene-type fuels used by commercial airlines, and the latter to the gasoline-type fuels used in small airplanes. The second is that legal or policy questions can arise about the applicability of a carbon tax to fuels used by the military or other government entities. Carbon tax drafters may inadvertently include or exclude such fuels depending on other state statues to which their bill refers.

Carbon taxes on home heating oil can be levied at the bulk storage terminals. Petroleum fuels embedded in products such as asphalt, plastics, and chemicals are not combusted, so states may find it appropriate to exempt them from the tax. For example, the ballot measure in Washington State covers all petroleum products and offers a partial or complete rebate or exemption for uses of fossil fuels (not just petroleum products) that firms can show do not increase atmospheric CO_2 concentrations.

Coal

Most coal is used to generate electricity; it can be taxed at the power plant (see below) or upon arrival in a state. Other uses of coal (e.g., for industrial purposes) may be covered by the EPA data discussed above.

Natural gas, propane, and related fuels

Carbon in natural gas, propane, and related fuels can be taxed upon arrival in a state and/or at the power plant (see below). States with wells or processing facilities may also have emissions (e.g., flaring) associated with producing those fuels. These emissions, at least from large sources, should appear in the EPA database.

Electricity

In principle, states can tax carbon emitted by electricity generators on the generators themselves, on the local distribution companies, or on consumers. Taxes levied on the consumer can be collected by utilities or local distribution companies in the same way that sales taxes are collected by retailers.

Power that is both generated and consumed in-state naturally fits in the tax base, but the tax treatment of imported power (power that is consumed in-state but generated out-of-state) or exported power (power that is generated in-state but consumed out-of-state) is less obvious.[42]

[42] The Washington State I-732 proposal, for example, taxes both imported power and exported power.

To avoid dormant Commerce Clause challenges, states may have to provide credit against similar carbon taxes paid in other states on electricity that is generated in that other state, but complex issues arise when one state prices carbon and surrounding states in the same grid do not.

Imported electricity

A state must decide whether to tax the carbon emitted in the process of generating electricity imported from other states. In general, it makes sense to do so in order to avoid distortions in sourcing electricity, but when utilities buy power from a multi-state grid, it may not be obvious how to assign a carbon intensity to the imported electricity. Some states require utilities to file Fuel Mix Disclosure Reports, and that data can be a starting point for a carbon tax based on electricity consumption.[43]

California faced this issue in its design of the cap-and trade-program, as the state imports electricity from surrounding states and Mexico. California made a distinction between imports from a "specified" generation source, i.e. one owned by or contracted by the importer, and other sources. The California regulatory authority assigned emission factors to all power plants inside and outside California that the agency recognizes as "specified" sources. "Unspecified" imports, such as those from a spot market are a more significant policy challenge. It is possible to calculate the average carbon content for the electricity traded through a spot market, but using an average value can create an incentive for high-carbon electricity to be laundered through the spot market.

The tax treatment of imported electricity can be more complex for states participating in organized wholesale markets, i.e. a regional transmission organization (RTO) or independent system operator (ISO). Within those markets, essentially all power sources are unspecified because all sources bid into a common market. Some states participate in more than one of these organizations, and some states have areas both inside and outside an RTO or ISO.[44]

California's regulator applies a default emissions factor that corresponds to the emissions from a relatively efficient natural gas combined-cycle power plant.[45] Treating imported electricity as if it was generated by coal, the most carbon-intensive fuel, avoids incentives for carbon

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[43] The I-732 proposal in Washington State, for example, imposes a tax on consumers of electricity that is collected and paid by utilities; the tax is based on reports similar to Fuel Mix Disclosure Reports, and then (to avoid double-counting) a credit is provided against carbon taxes already paid on in-state consumption of fossil fuels used to generate electricity. For imported power, the proposal would give a credit for any carbon taxes paid to other states.

[44] http://www.ferc.gov/industries/electric/indus-act/rto.asp

[45] James Bushnell, Yihsu Chen, and Matthew Zaragoza-Watkins, "Downstream Regulation of CO_2 Emissions in California's Electricity Sector," *Energy Policy*: 64: 313-323 (2014).

laundering, but it inappropriately burdens lower carbon electricity producers who sell into the spot market.[46]

Exported electricity and fuels

A major question for fossil fuel-producing states such as Wyoming, Montana, and North Dakota, as well as states like Washington that have refinery operations, is the tax treatment of fuels that they export to other states. Taxing those fuels could reduce the competitiveness of their extractive and refining industries relative to their competitors elsewhere, but it could also raise considerably more revenue and extend the price signal outside the state, potentially amplifying the emissions benefits of the tax. And, to the extent states can pass along higher (post-tax) prices to energy users outside the state, a tax on exported carbon could raise additional revenue without burdening a state's own residents.

For example, Gerarden et al. (2016) estimate that a carbon fee on coal extracted from federal lands, levied at the government's estimate of the social cost of carbon, would raise over a billion dollars each year through 2050 and reduce emissions in the U.S. electricity sector by an amount equal to three-fourths of the emissions reductions expected from the Clean Power Plan.[47] Their work suggests that (if such a policy could withstand legal challenges and obvious political impediments) states like Wyoming, which has highly productive mines in the Powder River Basin, could impose a carbon tax on coal produced there and export much of the economic incidence of the tax to out-of-state buyers of the coal. Because these states have such low costs and a relatively large market share, the tax would cause after-tax coal prices to go up. Buyers would pay more per ton of coal and shift back their demand for coal overall, with the net effect of lower revenue to coal companies but higher revenue to the state, mostly from people outside the state. However, some of the economic incidence would also fall on coal companies and workers, consumers of coal within the state, and railroads, to the extent that they adjust their monopoly margins to maintain deliveries.[48] States could use the revenue to offset burdens within their states have still have money left for other purposes.

The dynamics of the oil and gas industry are somewhat different, and it could be difficult in more competitive markets for any one state to pass along the incidence of its carbon tax on those fuels to purchasers outside the state. For example, I-732 in Washington State would tax carbon embodied in refinery products if they're consumed in Washington. Products refined in Washington but sold in, say, Oregon, are not subject to the tax. To be sure, refineries in

[46] The ballot initiative in Washington State makes this default assumption about imported electricity from unspecified sources.
[47] Gerarden, Todd, W. Spencer Reeder, and James H. Stock, "Federal Coal Program Reform, the Clean Power Plan, and the Interaction of Upstream and Downstream Climate Policies," April 2016. See Figure 10 for coal production and revenue estimates. http://scholar.harvard.edu/files/stock/files/fedcoal_cpp_v9.pdf?m=1461850687
[48] Gerking et al 's http://eadiv.state.wy.us/mtim/StateReport.pdf

Washington would pay the tax on all of their direct emissions, but the carbon embodied in their products would only be taxed if they are destined for combustion within the state. This points, however, to the potential for fuel-producing states to work together to harmonize carbon tax policies; more on this below.

States that export electricity to their regional grids must decide whether to rebate any taxes paid by their generators or fuel suppliers. As with primary fuels, the economic and environmental outcomes of taxing carbon emitted while generating exported electricity depends on the competitiveness of the markets into which the power is sold. If the utility can pass along the tax incidence to residents in other states, then the tax may generate emissions reductions outside the state as a result of higher electricity prices. If not, depending on the nature of the generation mix, the carbon tax may make the state's utility less competitive, and thereby lower emissions internally by reducing generation within the state.

Changes in other fuel taxes and revenues

States may consider whether to reduce or eliminate existing gasoline or other fuel excise taxes when they adopt a carbon tax, an approach called fiscal cushioning. Of course, such an approach could significantly reduce both potential net revenue and the abatement incentives created by the carbon tax, but if the new tax rises over time in real terms and the tax it replaces was fixed, the carbon tax would increase *expected* prices and drive investment accordingly, even if in the short term the observed price signal is no higher than the tax it replaced. If states impose a carbon tax on top of other fuel excises, that will tend to lower revenues from those other instruments by virtue of further discouraging the consumption of taxed products.

Another consideration arises in states with fossil fuel extraction taxes, such as severance taxes or royalties. A number of these states, including Alaska, Wyoming, and West Virginia, are experiencing sharp downturns in revenues associated with oil, gas, and coal production as the prices and/or production volumes decline. A carbon tax could replace some of these lost revenues. One important difference between a carbon tax and these other extraction-related taxes is that a carbon tax is a function only of the quantity of each fuel produced, and not the price. Thus, a carbon tax may be a less-volatile source of revenue than a severance tax.

Harmonizing policies across jurisdictions

Harmonizing carbon price policies across states (and perhaps federal or sub-federal jurisdictions in Canada, Mexico, and elsewhere) would simplify compliance for large firms, allow more upstream taxation, and help avoid driving investment and emitting activities to other jurisdictions, a phenomenon known as leakage. Formal linking, such as with a cap-and-trade system is one way to do this, but it is certainly not the only approach. Coordinating institutions can offer model tax legislation, analytical resources, and other tools that that could help states develop their policies and promote common policy design elements, such as points of taxation, carbon price trajectories, treatment of imported and exported fuels and electricity, and other approaches that would facilitate trade and reduce investment distortions. This work could also include states and provinces with cap-and-trade programs. For example, they could harmonize their floor prices on allowance auctions with tax levels in other jurisdictions.

Precedents for this kind of cooperation include the IFTA fuel tax arrangement discussed earlier. In addition, the Multistate Tax Commission advises states on the adoption of uniform tax policies to simplify the tax code and ease the burden on interstate commerce. These discussions could extend to the context of carbon tax design. [49]

To be sure, this hardly lays out an economically ideal approach to the mitigation of global climatic disruption. While far better than nothing, even a reasonably coordinated collection of state and provincial carbon pricing policies, in part derived from a patchwork of federal regulations and supplemented by a collage of other federal and sub-national policies, would create inefficiently disparate abatement incentives across sources, gases, sectors, and jurisdictions. Relying on state action also complicates international negotiations around both emissions targets and carbon prices. For example, it is difficult for the U.S. State Department to make a strong case to other countries that the United States will achieve a particular emissions goal by a certain date if the policies to attain it are directed by state actors over which the federal government has little control. Arguably, a more comprehensive approach, across and within major economies, will prove indispensable to achieve ambitious GHG stabilization targets at reasonable cost. But in the absence of new federal legislation in the United States, this scenario of state and provincial coordination is about as good as it could get.[50]

Tax rates and trajectories

States must set an initial tax rate and decide how it should evolve over time. A tax rate that starts too low or rises too slowly would delay investments in cleaner energy and do little to abate emissions. On the other hand, excessive rates of increase would provoke opposition (even repeal), strand long-lived capital, and potentially drive investment elsewhere. Thus the setting of a carbon tax rate and its adjustment over time is as much art as it is science.

[49] http://www.mtc.gov/

[50] A scholarly debate surrounds whether the EPA could invoke Section 115 of the Clean Air Act to address multiple sources of GHGs with a single proceeding, thus paving the way for a national market-based climate program. See https://law.ucla.edu/centers/environmental-law/emmett-institute-on-climate-change-and-the-environment/publications/legal-pathways-to-reducing-greenhouse-gas-emissions-under-section-115-of-the-clean-air-act/; https://niskanencenter.org/blog/section-115-not-a-viable-climate-policy-option/ .

Setting the tax rate at a reasonable estimate of the emissions' marginal damages to the environment (the social cost of carbon, or SCC) ensures that the benefits of abatement are greater or equal to the tax rate. However, current estimates of the global social cost of carbon used by the U.S. federal government may be higher than politically acceptable tax rates in any given state.[51] For example, the four global SCC estimates for 2015 are: $11, $36, $56, and $105 (in 2007 dollars) per metric ton of CO_2. The high value represents the SCC under a scenario of higher-than-expected impacts from temperature change. Even if the figure is scientifically justifiable, a tax at that level would raise gasoline prices by more than a dollar per gallon, risking sharp voter backlash. An alternative may be to choose a tax rate that approximates a U.S.-only SCC or some other value that strikes a balance between ambition and willingness-to-pay in a given state.

A gradual and predictable policy would promote efficient turnover of long-lived industrial plants and equipment, allow households to adjust with minimal disruption, and incentivize innovation and deployment of new technologies. Some economists recommend that the real rate of increase in a tax should match the returns on relatively low-risk capital assets, which is about four or five percent above inflation.

Revenue neutrality

A few special considerations arise in designing a revenue-neutral approach in which carbon tax revenues fund equal reductions in other taxes. In this context, in addition to the revenue forecast for the carbon fee, policymakers need forecast other changes in the revenue system. First, they need to account for how the carbon tax may reduce revenues of other taxes. For example, if people spend more on energy they may spend less on other goods. That may result in lower sales tax revenue than would otherwise occur. Second, policymakers must anticipate how adjustments to other taxes (such as personal or corporate income tax rates) will affect those revenues and adjust the shifts to balance out all the revenue effects.

One option is to structure the tax swap so that it is revenue neutral in expectation, recognizing that in practice there will likely be some net revenue increase or decrease. Another option would be to update tax rates so that each year or multi-year period the revenues balance out. For example, British Columbia cuts income and corporate taxes to offset the revenues the province receives from its carbon tax.[52]

[51] https://www3.epa.gov/climatechange/EPAactivities/economics/scc.html

[52] Experience suggests that carbon pricing policies can start off with one set of principles for using the revenue, but evolve to include other objectives. For example, see Murray, Brian C. and Nicholas Rivers, "British Columbia's Revenue-Neutral Carbon Tax: A Review of the Latest 'Grand Experiment' in Environmental Policy," Nicholas Institute Working Paper15-04. Durham, NC: Duke University. May 2015. https://nicholasinstitute.duke.edu/sites/default/files/publications/ni_wp_15-04_full.pdf

Finally, it may not make sense to return all of the revenue through tax cuts per se. For example, suppose policymakers wish to target some of the revenues to low income households, coal workers, or disadvantaged communities. It may be preferable to channel those resources through the spending side of the budget, for example through existing state programs that benefit low income households.

Tax credits

States may choose to credit or exempt carbon in fossil fuels that is not ultimately emitted into the atmosphere, for example because it is embedded into products, such as plastics, or because the carbon is stored underground in a carbon capture and sequestration (CCS) project. One consideration for states is whether to cap the credit at a level that corresponds to the expected incremental cost of these technologies. Otherwise, the tax credit could significantly reduce revenues without necessarily prompting more abatement.

4. DISTRIBUTIONAL CONSIDERATIONS AND REVENUE USE

Policymakers are rightfully interested in the potential effects of a carbon tax on consumers, low income households and neighborhoods, rural communities, small businesses, and other stakeholders. All of those welfare effects depend on the overall package of policies involved in the carbon fee program, including the burden of the fee itself, the economic shifts the fee induces, and the distributional and efficiency outcomes of what the state does with the revenue.

Economic incidence of the tax

In general, lower-income households spend a higher percentage of their income on energy and other goods whose prices would go up under a carbon tax.[53] That suggests a carbon price could be regressive. However, its effect in reality is more complicated. Some of the tax will be passed backward to producers through lower wages for workers and lower returns to shareholders. A carbon tax could also substitute for other more- or less-regressive environmental policies. The incidence of a carbon tax depends heavily on what happens to the tax revenue. For example, devoting the carbon tax revenue to lowering corporate income taxes is more likely to be regressive than reducing state sales taxes.

Policymakers may consider a number of options for cushioning burdens on low and moderate income individuals, including means-tested dividends, targeted tax benefits, and expansions of existing social safety net programs. Approaches that offset the price signal, such as subsidies on

[53] For an example of the share of carbon tax burden by household income quintile, as estimated in Massachusetts, see page 47 of Breslow et al, "Analysis of a Carbon Fee or Tax as a Mechanism to Reduce GHG Emissions in Massachusetts," December 2014. http://www.synapse-energy.com/project/analysis-carbon-fee-or-tax-mechanism-reduce-ghg-emissions-massachusetts

energy bills, could blunt incentives to conserve energy and either lower the environmental benefits of the program or increase the costs of achieving the same environmental goal. Lump sum rebates, benefits through other social safety net systems, and other approaches would retain incentives to shift consumption away from emission-intensive goods while helping ensure that low income households are held harmless.

Macroeconomic outcomes

One potentially efficient use of carbon tax revenues is to reduce tax rates on labor and capital income, other business activities, and other distortionary revenue instruments. Income taxes reduce the returns of working and create a disincentive to work. Some people work slightly less than they otherwise would because to them that last hour of work just is not worth it once they factor in the taxes. The higher the marginal tax rate, the tax on the last dollar earned, the greater the disincentive to work. This tax-induced disincentive to work results in a lower-than-efficient amount of labor supply in the economy, and that inefficiency is costly. Likewise, taxes on capital income (like state corporate income taxes) lower investment, and that reduces future consumption below what it would have otherwise been.[54]

Research shows that using carbon tax revenue to reduce marginal tax rates on other revenue instruments can greatly improve the macroeconomics of a price on carbon.[55] The most efficient form of revenue recycling would offset the most distortionary taxes, meaning the ones that create the greatest excess burden for the last dollar they bring in. In general, state and local taxes on personal income and business activity tend to be more distortionary than taxes on things that are less mobile, such as property. At the federal level, some models of some policy scenarios suggest that carbon tax swaps can produce net pro-growth economic benefits—not counting the environmental benefits.

Thus, the tradeoffs across distributional and efficiency goals are challenging. While per-capita rebates carry some political appeal and are strongly progressive, they do not reduce any of the existing distortions in the tax system, so they do not lower the overall costs to the economy of the carbon tax. Conversely, rate reductions for personal and business taxes may promote economic growth, but they disproportionately benefit higher income households; they would do little to offset the regressive burden of the tax on lower income households. One option is to provide targeted benefits (via dividends or other policies) to the lowest income households and use the rest of the revenue for pro-growth fiscal reforms.

[54] A 2013 study of the British Columbia carbon tax concludes that "the average [BC] household is better off with the carbon tax than without. A key reason is that the government uses carbon tax revenue to reduce personal and corporate income taxes, making the province a more attractive jurisdiction for investment." http://www.naviusresearch.com/wp-content/uploads/2016/06/BC-Carbon-Tax-Full-Study.pdf

[55] A collection of modeling papers in this vein appears in the March 2015 issue of the *National Tax Journal*.

Revenue and competitiveness

One consideration for policymakers is whether or not the price signal would discourage new investment and induce economic activity in the state to move elsewhere. Ensuring that businesses do not face unfair competition from counterparts outside the jurisdiction is also a potent political issue. The first best resolution is to harmonize carbon pricing policies across jurisdictions to eliminate distortions in trade and investment. Other options include adopting modest carbon tax levels to start and increasing them gradually, giving firms predictable policies and time to adjust. States may also consider ways to apply the carbon fee revenue that make them more attractive to investment and business activity. For example, applying carbon tax revenue to reducing other business taxes can also help offset concerns about the competitiveness effects of a carbon price.

Despite these measures, concerns may remain. For example, California imports about half of its cement from China. How can California impose a carbon price on its cement plants when doing so would crush the state's firms' market share and shift emissions abroad?[56] At the national level, the issue can be reduced with border carbon adjustments (import taxes or export rebates adjust for disparate carbon policies). However, at the state level such border adjustments may be infeasible. One possible answer in the cap-and-trade context is to offer a sort of production-benchmarked free allocation of allowances. The clear analogy in a carbon tax context is an output-based rebate or tax credit of some kind.

A growing literature considers the design of output-based rebates, border adjustments, and other anti-leakage measures at the federal level.[57] However, much of this literature focuses on the legality of different approaches under international trade agreements; issues that arise at the state level are quite different. The design of these policies at the state level would be a fruitful area of research.

States with specific industries that are energy-intensive and face competitors in other jurisdictions may consider exempting those industries or providing them with special tax treatment that offsets the burden of the carbon tax. For example, the I-732 proposal in Washington State effectively eliminates an existing tax on manufacturers, and it phases in the

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[56] For an industry perspective see: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwjNiYjIvJPOAhWGJR4KHavOAKYQFgg2MAE&url=http%3A%2F%2Fwww.arb.ca.gov%2Fcc%2Fcapandtrade%2Fmeetings%2F041309%2Fapr13pccscme.pdf&usg=AFQjCNEIhsTCE28SkYx42Oz2_tjunxugCA&bvm=bv.128153897,d.dmo

[57] See, for example, Fischer, Carolyn and Alan Fox, "Comparing policies to combat emissions leakage: Border carbon adjustments versus rebates," *Journal of Environmental Economics and Management*, Volume 64, Issue 2, September 2012, Pages 199–216. A working paper version is available here: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=0ahUKEwjdk-jYrZLOAhXLqx4KHSThCJoQFggvMAI&url=http%3A%2F%2Fwww.rff.org%2Ffiles%2Fsharepoint%2FWorkImages%2FDownload%2FRFF-DP-09-02-REV.pdf&usg=AFQjCNFZTJRM-7410kpq_gXKOtHZ1kzPJA

carbon tax on fuels used in agriculture over 40 years. British Columbia, starting in 2012, exempted fuels used in agriculture from its carbon tax.

Policymakers would do well to keep competitiveness concerns in perspective and refrain from fostering rent-seeking that results in inefficient exemptions and special treatments. For example, research shows "little evidence that the [BC] carbon tax is associated with any meaningful effects on agricultural trade despite the sector being singled out as 'at risk' by the provincial government."[58]

5. COMPLIANCE WITH EPA REGULATIONS

This section describes how states can incorporate a carbon tax into their compliance plans for EPA regulations under Section 111 of the Clean Air Act.[59] Section 111, entitled "New Source Performance Standards," requires EPA to establish emission standards for pollutants from newly-built (and certain existing but modified) sources in dozens of separate "source categories" of emitters.[60] These categories are remarkably specific (e.g., kraft pulp mills, glass manufacturing plants, synthetic fiber production facilities, and Portland cement plants).

In 2015, EPA issued CO_2 emissions standards for new and significantly modified or reconstructed power plants using the agency's authority under Section 111(b) of the Clean Air Act.[61] The rule requires all applicable generating units to meet certain CO_2 limits on a unit-by-unit basis; the specific limit depends on the kind of technology the generating unit employs.[62] Thus, the regulation for new or updated plants is a hard limit on emissions (expressed in pounds of CO_2 per megawatt-hour generated) from each plant. By itself, a price on carbon cannot not guarantee compliance with this kind of unit-specific technical standard, but it can make lower-carbon technologies generally more economic.

The regulatory treatment of existing power plants is quite different, and in this context a carbon tax can play a central role. Although the title of Section 111 refers to new sources, Section 111(d) requires EPA to establish emission standards (a.k.a. "emission guidelines") for

[58] Nicholas Rivers and Brandon Schaufele, "The Effect of British Columbia's Carbon Tax on Agricultural Trade," Pacific Institute for Climate Solutions, July 2014, and "The Effect of Carbon Taxes on Agricultural Trade," *Canadian Journal of Agricultural Economics* Volume 63, Issue 2, pages 235–257, June 2015. http://pics.uvic.ca/sites/default/files/uploads/publications/Carbon%20Tax%20on%20Agricultural%20Trade_0.pdf

[59] 42 U.S.C. § 7411. This section draws in part from: Wara, Michael, Adele Morris, and Marta Darby, "How the EPA should modify its proposed 111(d) Regulations to allows states to comply by taxing pollution," Brookings, October 28, 2014. http://www.brookings.edu/~/media/research/files/papers/2014/10/28commentsonepa111dtaxingpollutionmorris.pdf

[60] https://www.epa.gov/compliance/demonstrating-compliance-new-source-performance-standards-and-state-implementation-plans

[61] https://www.epa.gov/cleanpowerplan/carbon-pollution-standards-new-modified-and-reconstructed-power-plants

[62] https://www.epa.gov/sites/production/files/2015-11/documents/fs-cps-overview.pdf

certain pollutants from existing sources in each category after EPA has promulgated an emission standard for that pollutant for new emitters.[63] Since CO_2 is a 111(d) pollutant, EPA will establish CO_2 emission guidelines for existing emitters in each source category. However, unlike the process for standards applicable to new sources, Section 111(d) requires all states with relevant emissions to submit a plan to EPA that sets out how they will ensure their sources comply. This is called the State Implementation Plan, or SIP.

In August of 2015, EPA finalized its first 111(d) CO_2 emissions guidelines, the Clean Power Plan (CPP). The rule limits CO_2 from most fossil-fuel fired power plants, which comprise about a third of overall GHG emissions in the United States.[64] In February 2016, the U.S. Supreme Court stayed the implementation of the rule pending further proceedings, which could take into 2018. The court wrote: the CPP "is stayed pending disposition of the applicant's petition for review in the United States Court of Appeals for the District of Columbia Circuit and disposition of the applicant's petition for a writ of certiorari, if such writ is sought."[65] That means, at a minimum, the stay will continue until there is a decision from the DC Circuit court, which will not be until sometime in early-to-mid 2017. The losing party will likely seek a Supreme Court review of the decision. If the court denies this (which is unlikely), the stay will last into late 2017; if the court grants the petition (likely), then the stay will remain in effect until the Supreme Court issues its decision, probably sometime in 2018. At that point, the provisions of the rule will depend on the details of the court's decisions. For the purposes of this paper, let us assume that eventually states must go forward with policies that will satisfy the CPP (or a similar rule, subject to court revisions) and future EPA regulations under Section 111 of the Clean Air Act. Indeed, a number of states are continuing their preparations for compliance with the standards in the final rule.[66]

For a variety of reasons, instead of establishing a CO_2 emission standard that would apply to each coal-fired power plant (and a separate standard to apply to each gas-fired plant), EPA elected to treat all of the power plants in a state collectively, and thus set collective, state-specific goals for CO_2 emissions from these power plants.[67]

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[63] *See* 42 U.S.C. § 7411(d)(1), (2). Section 111(d) applies only to emissions not otherwise regulated under Sections 110 or 112 of the Clean Air Act. Emissions for which EPA has promulgated a national ambient air quality standard (NAAQS) under section 109 are regulated under section 110. 42 U.S.C. § 7411(d)(1)(A)(i). EPA regulates hazardous pollutants under section 112. EPA has not promulgated a NAAQS for CO_2, nor has it designated CO_2 emissions a hazardous pollutant.

[64] https://www3.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2016-Main-Text.pdf

[65] http://www.scotusblog.com/wp-content/uploads/2016/02/15A773-Clean-Power-Plan-stay-order.pdf

[66] For example, California has issued a "preliminary draft Proposed Regulation" http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwi_qraR2ZPOAhWD1x4KHe_9A7IQFggjMAE&url=http%3A%2F%2Fwww.arb.ca.gov%2Fcc%2Fcapandtrade%2Fdraft-ct-reg_071216.pdf&usg=AFQjCNEzKSoIZ4gEA-V_ITAXAD-GYvYYdA.

[67] As a legal matter, EPA actually established such standards, but since no existing coal-fired power plant could meet the applicable standard the collective state standard is the de facto standard.

The CPP expresses its state-specific standards in two forms: a limit on the number of pounds of CO_2 emitted per megawatt hour (lb/MWh) generated (the "rate standard") or as a total mass (in tons) of CO_2 emitted (the "mass standard").[68] Each state gets to choose which form to comply with, and both sets of standards reflect the degree of emission limitation that EPA determined can be achieved through the application of the "best system of emission reduction" that, "taking into account the cost of achieving such reduction and any non-air quality health and environmental impact and energy requirements, the [EPA] Administrator determines has been adequately demonstrated."[69] CPP compliance occurs in two phases; covered sources in each state must meet three interim targets between 2022 and 2029 and a final target in 2030 and thereafter.

The bottom line is that every state has to reduce total emissions from the regulated plants in their borders so that they meet either the rate or mass standard applicable in the state. States can cooperate in their efforts so that one state can go over its target by an amount that another state is under its target, but they all need SIPs that show that they will comply, individually or collectively.

EPA can approve, reject, or conditionally approve the state plans. In the CPP, EPA has emphasized the wide flexibility states have to achieve their interim and final targets. Flexibility is important because states have very different existing emissions levels, costs of abatement, regulatory structures, and electricity demands. In doing so, EPA specifically stated that states may employ a carbon tax to achieve their CO_2 targets: "the state measures plan type could accommodate imposition by a state of a fee for CO_2 emissions."[70]

EPA has not yet issued guidance to states on how to demonstrate the sufficiency of their carbon taxes or other measures that do not directly cap emissions or emissions rates. It will likely require modeling the impacts of the policies, along with policies of other states, on regional electricity markets and demand for electricity in the state. The agency does require that state measures plans (of all kinds, not just ones that include a carbon fee) include a federally enforceable backstop of emissions standards.[71] These standards would be triggered if the state measures fail to result in the affected plants achieving the required emissions limits on schedule.

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[68] EPA asserts that each state's rate and mass standards are equivalent.
[69] 42 U.S.C. § 7411 (a)(1) and (d).
[70] 80 Fed. Reg. 64836 (October 23, 2015). For a legal analysis of this point, see: Eisenberg, Samuel D., Michael Wara, Adele Morris, Marta R. Darby, and Joel Minor, "A State Tax Approach to Regulating Greenhouse Gas Emissions Under the Clean Air Act," Brookings, May 22, 2014. http://www.brookings.edu/~/media/research/files/papers/2014/05/22-state-approach-regulation-ghgs-clean-air-act-morris/state_approach_regulating_ghgs_morris.pdf
[71] https://www.epa.gov/cleanpowerplan/fact-sheet-clean-power-plan-key-changes-and-improvements

6. CARBON TAX VS. OTHER CLIMATE POLICY OPTIONS

Policymakers should compare a carbon tax to other options to achieve the same goals. The analysis depends on which goal one considers. We reviewed a carbon tax relative to other taxes it could replace in Section 4. Here we compare a carbon tax to other climate policies.

Clean Power Plan and other Clean Air Act rule compliance

The CPP gives states wide flexibility in how they reach their emissions targets. For example, states can join existing cap-and-trade programs like AB32 and RGGI, they can beef up existing renewable portfolio standards (RPS) and other regulations, or they can adopt a carbon excise tax on the regulated sources.

An important consideration in choosing a CPP compliance strategy is the extent to which the policy can be easily extended to additional source categories EPA will regulate under section 111(d). For example, an RPS is specific to electricity production; the approach is not amenable to extension to oil refineries or cement plants. Likewise a cap-and-trade system approach to CPP compliance cannot incorporate future regulated emissions under a single cap because under Section 111, EPA must set separate (non-fungible) guidelines for each source category. States would need separate registries and allowance markets for each category of emissions. In other words, EPA cannot allow states to over-comply in their electricity sector and equally under-comply in their glass manufacturing sector and call it good.

One advantage of a carbon tax implementation strategy relative to those other options is that states can easily expand their tax bases with each additional regulated source category. Using a common administrative structure, states would set a tax rate for each category designed to achieve EPA's category-specific emissions target. The tax rates could differ across regulated categories, depending on the expected marginal abatement costs for the different 111(d) guidelines. Alternatively, states could choose a single tax rate high enough to achieve the goals for all source categories, albeit with the outcome that they would over-comply with some.

The administrative advantages of a carbon tax could be particularly valuable in states without a large regulatory staff. Carbon taxes are administratively much simpler for a small state air regulator than cap-and-trade or other tradable standards programs would be. First, the air regulator probably wouldn't even have to administer the tax; that would be the Department of Finance's job and they may have existing tax programs that would be easily supplemented with a carbon charge. Further, the air regulator would not have to develop a registry, administer an allowance auction or other allowance distribution system, monitor and record trades, or design and enforce rules to prevent monopoly behavior in allowance markets. These are not small responsibilities. The California Air Resources Board does these activities, but the agency has over 130 full time staff devoted just to climate change.[72] Air regulators in smaller states, unless they can outsource these obligations to EPA or another state, could find the administrative benefits of a tax approach relative to cap-and-trade considerable. Moreover, if states do link with California's allowance trading program to exploit its existing policy infrastructure, the linkage would come with a lack of control over the prevailing carbon price, the transfers that can arise across states and stakeholders, the challenge of ensuring sector-specific compliance under EPA regulations, and other aspects of the policy design about which they may care.

One potential drawback of an excise tax approach to CPP compliance is that in all likelihood states must pass a new law to impose it. The requirements for legislating new taxes or fees vary from state to state, with some requiring a supermajority, as the case in California illustrates. On the other hand, many states will have to amend state law to adopt other policies to implement the CPP. A carbon tax, especially if state fiscal reforms are desirable for other reasons, might be no heavier lift than other legislative or regulatory changes that could implement the EPA rule.

Finally, along with all other approaches that do not strictly cap emissions or emissions rates, a tax approach by itself does not guarantee compliance. In their SIPs, states would have to explain to EPA how they would adjust the tax or other policies if emissions do not fall as anticipated.

Economy-wide emissions reductions

States can use a variety of policies to lower emissions across the economy. Options include clean energy standards, subsidies, command and control regulations, and energy efficiency standards. A carbon pricing approach, including a tax, is likely to be more economically efficient than other policies for several reasons. First, it is very hard to target subsidies and mandates toward the most cost-effective abatement, both because the government does not know which technologies will be least costly and because it is hard to implement a program that is not prone to political favoritism. Second, it is nearly impossible to preclude subsidizing abatement that would happen anyway or mandating activities that are more costly than the avoided damages to the environment. Clean energy subsidies can also have the perverse effect of increasing the overall supply of energy and making prices fall, partly offsetting the benefits of the subsidies.[73]

A carbon tax is also more efficient than standards for renewable electricity and similar policies because it generates market signals throughout the energy supply chain. For example, the price

[72] http://www.ebudget.ca.gov/2015-16/StateAgencyBudgets/3890/3900/spr.html. Climate staff comprise about 10 percent of the total workforce of the California Air Resources Board.
[73] Morris and Mathur (2014)

signal incentivizes energy conservation at all levels, from industrial to wholesale to retail, which regulatory standards may not.[74] Also the tax incentivizes lower-carbon fossil fuels (such as natural gas) in electricity generation (which renewable electricity standards do not) and more-efficient coal-fired electricity (which clean energy standards do not). Creating market signals that promote lower GHG technologies also incentivizes the development of new technologies, although that effect is most important in larger states and at the national level.

One potential advantage of a carbon tax over cap-and-trade, both at the federal and state levels, is that if it is imposed on top of existing climate and energy policies, it can incentivize additional abatement up to the marginal costs reflected in the tax rate. In contrast, the primary effect of supplementary policies in a cap-and-trade program is to aid achievement of the cap and lower the trading price of allowances; abatement below the cap is not incentivized. Indeed, the role of supplementary policies has been implicated in the below-expectations prices of allowances in the RGGI, AB32, and European carbon cap-and-trade programs. To be sure, imposing a floor price in allowance auctions can support the prices, but in that case policymakers may have just as well imposed a tax, which would not have required the whole emissions trading policy apparatus.

[74] Fischer, Carolyn. "Renewable Portfolio Standards: When Do They Lower Energy Prices?" The *Energy Journal* 31 (2010): 101-19.

THE BROOKINGS INSTITUTION
1775 MASSACHUSETTS AVE., NW
WASHINGTON, DC 20036
WWW.BROOKINGS.EDU